

# HARDY-WEINBERG EQUILIBRIUM WEBQUEST

Name: \_\_\_\_\_

**Directions:** Please go the website

[http://www.phschool.com/science/biology\\_place/labbench/lab8/intro.html](http://www.phschool.com/science/biology_place/labbench/lab8/intro.html).

## 1. Read the Introduction: What is the Hardy-Weinberg Law of Genetic Equilibrium?

### 2. Click Next.

*The Hardy-Weinberg Law of Genetic Equilibrium*

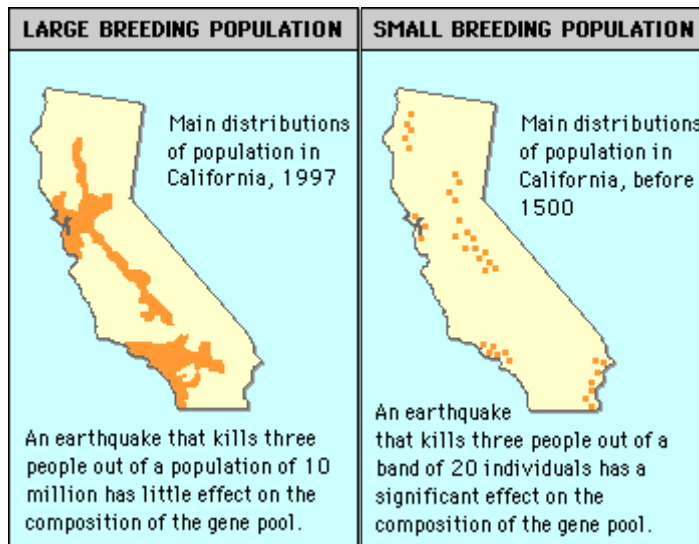
In 1908 G. Hardy and W. Weinberg independently proposed that the frequency of \_\_\_\_\_ and genotypes in a population will remain constant from generation to generation if the population is \_\_\_\_\_ and in genetic equilibrium. Five conditions are required in order for a population to remain at [Hardy-Weinberg equilibrium](#):

#### a. What is an allele? (Hint: Click on the link) \_\_\_\_\_

### 1. Click on → A Large Breeding Population.

Read the excerpt and study the image to the right →

Q. What is genetic drift?

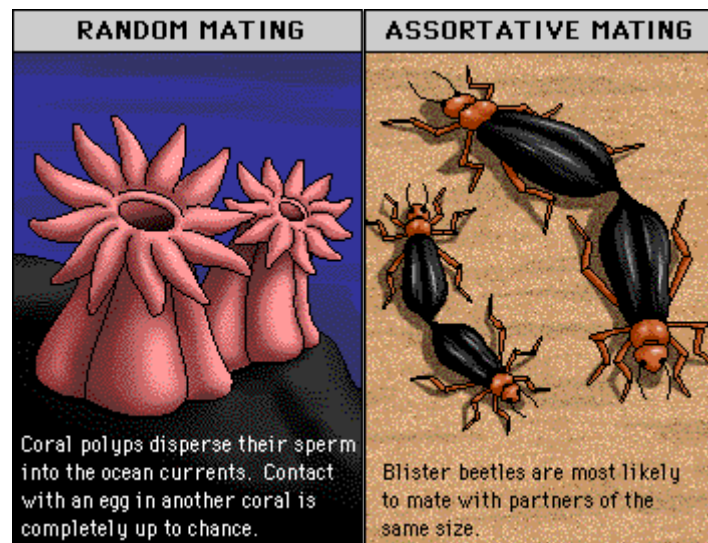


Q. Why is a large population necessary to maintain genetic equilibrium? \_\_\_\_\_

### 3. Click Next Concept → Random Mating

Q. Why is a large population necessary to maintain genetic equilibrium? \_\_\_\_\_

Q. What does it mean to be heterozygous? \_\_\_\_\_



#### 4. Click Next Concept → **NO MUTATIONS**

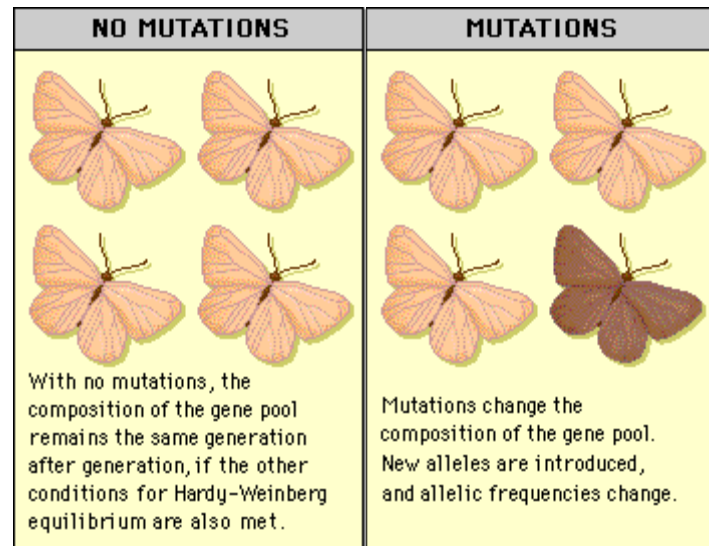
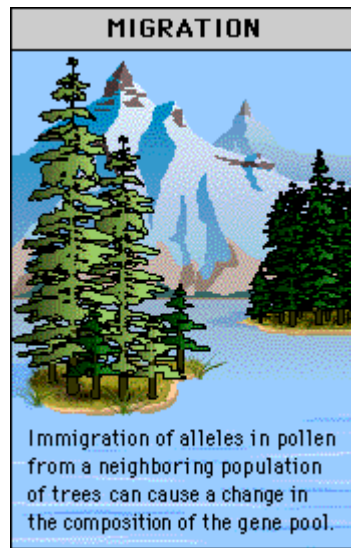
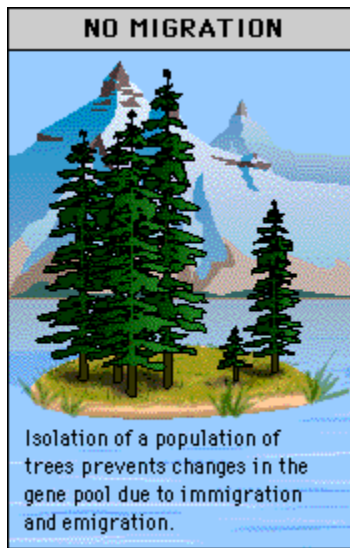
Q. What would happen if to the gene pool if a mutation occurs?

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#### 5. Click Next Concept → **No Immigration or Emigration**



Q. What is migrating into this population of trees that can alter the gene pool?

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#### 6. Click Next Concept → **No Natural Selection**

Click Spray!

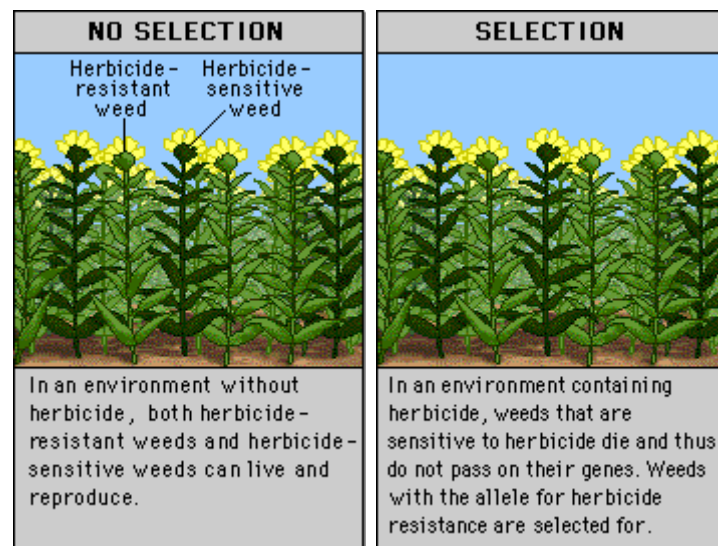
Q. Which type of weeds will pass on their genes after being sprayed with herbicide?

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#### 7. Click Next Concept. **Piggies!**

Q. How many recessive alleles do you count? \_\_\_\_\_

#### 8. Check your answers.



Q. Why can't you count the number of recessive alleles just by looking at the phenotypes of the piggies?

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**9. Click Next Concept. This page is copied below so you can refer back to it.**

To estimate the frequency of alleles in a population, we can use the Hardy-Weinberg equation. According to this equation:

$p$  = the frequency of the dominant allele (represented here by  $A$ )

$q$  = the frequency of the recessive allele (represented here by  $a$ )

For a population in **genetic equilibrium**:

$p + q = 1.0$  (The sum of the frequencies of both alleles is 100%.)

$$(p + q)^2 = 1 \text{ so } p^2 + 2pq + q^2 = 1$$

The three terms of this binomial expansion indicate the frequencies of the three genotypes:

$p^2$  = frequency of  $AA$  (homozygous dominant)

$2pq$  = frequency of  $Aa$  (heterozygous)

$q^2$  = frequency of  $aa$  (homozygous recessive)

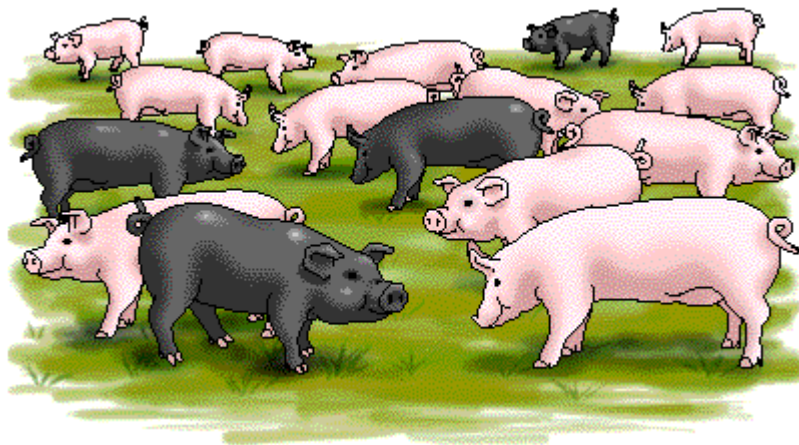
**10. Click Next Concept. Calculations: Record your answers in the space provided. You can check your answers at any time.**

1. Calculate  $q^2$ . (Hint: Count up the number of black piggies and divide by the total number of piggies). \_\_\_\_\_

2. Find  $q$ . \_\_\_\_\_

3. Find  $p$ . \_\_\_\_\_

4. Find  $2pq$ . \_\_\_\_\_



**11. Click Next Concept. Try Sample Problem 2.**

How many flies have red eyes? \_\_\_\_\_

How many flies have sepia eyes? \_\_\_\_\_

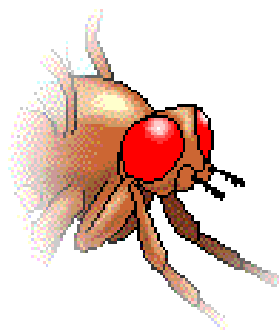
Which trait is dominant? \_\_\_\_\_

a. Find  $q^2$ . (percent of recessive organisms) \_\_\_\_\_

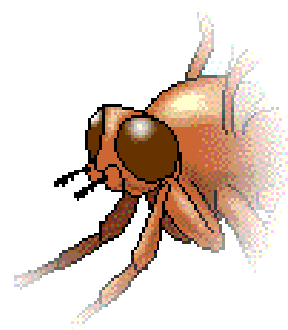
b. Find  $q$ . (take square root of this number) \_\_\_\_\_

c. Find  $p$ . (Using the equation  $p+q=1$ ) \_\_\_\_\_

d. How many can you expect to be homozygous dominant? \_\_\_\_\_ (Hint:  $p^2$ )



Red eyes



Sepia eyes

**12. Click Next Concept. Sample Problem 3: PKU in humans.**  
**(Causes mental retardation).**

The Hardy-Weinberg equation is useful for predicting the percent of a human population that may be heterozygous carriers of recessive alleles for certain genetic diseases. Phenylketonuria (PKU) is a **recessive** human metabolic disorder that results in mental retardation if it is untreated in infancy. In the United States, one out of approximately 10,000 babies is born with the disorder. Approximately what percent of the population are heterozygous carriers of the recessive PKU allele?

Find  $q^2$ . \_\_\_\_\_

Find  $q$ . \_\_\_\_\_

Find  $p$ . \_\_\_\_\_

Heterozygous carriers? \_\_\_\_\_

(Hint: Use  $2pq$ )

**13. Click Next Concept → Allelic Frequency vs. Genotypic Frequency**

If you are told that the frequency of a recessive allele in a population is 10%, you are directly given  $q$ , since by definition  $q$  is the frequency of the recessive allele. This comprises all the copies of the recessive allele that are present in heterozygotes as well as all the copies of the allele in individuals that show the recessive phenotype.

Q. What is  $q$  for this population? \_\_\_\_\_



Recessive



Dominant

**Sample Problem**

If you observe a population and find that 16% show the recessive trait, you know the frequency of the  $aa$  genotype. This means you know  $q^2$ .

Q. What is  $q$  for this population? \_\_\_\_\_

**Give yourself a pat on the back! You just survived the Hardy-Weinberg Madness!! Now, hand it in and I'll give you some points for your fabulous work.**